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THE CHEMIST IN THREE WARS[1]

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THE CIVIL WAR

AT the beginning of the Civil War chemistry was in its infancy. The chemical requirements of armies at that time were, of course, proportional to the world's contemporary scientific standards; they comprised in the main the procurement of a few basic materials such as iron, copper and saltpeter; among manufactured products, gunpowder was the most important. Small as these demands appear when compared to those of modern fighting forces, they constituted problems of magnitude for the chemists and industrialists of the time.

The agricultural South, having built its economic structure on cotton, found itself in a precarious position at the outset of the conflict. According to census figures for the year ending June 1, 1860, the United States had produced in twelve months 884,474 tons of pig iron; out of this total the South, represented only by Tennessee and Virginia, had contributed a mere 25,513 tons. The blast furnaces in the South were small and antiquated; a daily output of thirteen tons, reached by newly erected furnaces in Alabama, was considered a decided improvement over the older plants of Virginia and Tennessee. The methods used were obsolete, chemical control unknown. In many cases iron ore and fuel had to be brought from distant places by a dilapidated railroad system or by teams; nevertheless, the Confederacy is said to have produced 50,000 tons annually during the war—a remarkable achievement, especially in view of the

[1] A paper read before the American Institute of Chemists at Chicago, September 18, 1942.

fact that, as the Northern armies advanced, many furnaces had to be abandoned. To augment the supply, collection of scrap iron was instituted early in the war, much along the lines we follow to-day, with Richmond appealing to her patriotic citizens to give up their "broken or worn-out ploughs, plough-points, hoes, spades, axes, broken stoves and kitchen utensils" against adequate compensation.[2] Similarly, lead was collected successfully from various sources. 200,000 pounds were gathered from window-weights in Charleston alone, and a like amount was obtained from lead pipes in Mobile. Large amounts of lead were also systematically recovered from battlefields, and the government paid high prices for the metal so collected.

The only copper mines available for exploitation were located in Tennessee, and these passed into Union hands soon after the beginning of hostilities. Copper was sorely needed for bronze field-guns and for percussion caps. In this exigency, the South bought up turpentine and apple-brandy stills, which were made of copper and of which there was an abundant supply. By stopping the casting of bronze guns and limiting the use of copper to the manufacture of caps, a shortage of this metal was avoided.

In regard to saltpeter the South was relatively better off than her adversary. There were deposits in limestone caverns near Columbia, Charleston, Savannah, Augusta, Mobile and Selma. These were mined under supervision of a special government agency called the Nitric and Mining Bureau. Less than one half of the saltpeter needed was procured in this way; the rest came from other domestic sources and through the blockade.

The direction of all chemical activities in the South was in the hands of three men, to whose energy and ingenuity history has accorded but scant recognition. To earn the world's applause, heroes must—as we chemists know only too well—do something more spectacular than provide their country with sorely needed products, even if it is military ordnance for hard-pressed armies at the front. These three men, on whom nearly as much depended as did on Robert Lee and Joseph Johnston, were Josiah Gorgas, Gabriel J. Rains and John Wm. Mallet. General Gorgas was a Pennsylvanian by birth and had graduated from the U. S. Military Academy in 1841. As an officer in the ordnance office of the United States Army he had shown such outstanding ability that Jefferson Davis appointed him chief of ordnance of the Confederacy as early as February, 1861.[3] He was an organizer of the highest type, possessed of courage, initiative and a driving force that overcame the most discouraging obstacles. General Rains was equally dynamic, resourceful and persevering. Born in North Carolina and graduated from the U. S. Military Academy class of 1842, he was a resident of New York in 1861, but joined the Southern forces as colonel of infantry in March of that year. In September he was made brigadier general and fought with distinction at Shiloh, Perryville and Seven Pines, where he was wounded. But his ability as a chemist was soon recognized, and he was asked to turn his energy from leading troops on battlefields to the less colorful but equally essential task of creating a chemical industry.[4]

The third man of this small group was John William Mallet, an Irishman educated at Trinity College, Dublin, and at Göttingen, Germany. He had taught chemistry at Amherst and at the University of Alabama in the decade preceding the war and was made superintendent of the ordnance laboratories at Macon, Ga., in 1862. One of his principal assignments was the procurement of mercury for the Southern arms, which proved difficult without any native sources of quicksilver. Mallet remedied this shortage, at least partially, by ordering the breaking up of all thermometers and barometers throughout the South. After the war, Mallet became professor of chemistry at the University of Virginia, and in 1882 was elected president of the American Chemical Society.[5]

In 1861, this trio of chemical engineers faced a desperate situation. Only two of the country's powder mills were located in the South, one in South Carolina, built for the sole purpose of furnishing powder for blasting a tunnel, and one at Nashville, which was exposed to enemy attack. The South Carolina plant employed a crew of three men, the one at Nashville a crew of ten. Both together could produce scarcely enough powder for anything more than frontier skirmishes.[6]

Gorgas immediately took steps to put the manufacture of powder on a solid and broad basis. With Rains in actual charge, a large mill was started at Augusta, Georgia, in September, 1861; operations began seven months later. The Augusta plant remained the chief reliance of the Confederacy until the end of the war and furnished all the powder needed, and of the finest quality. Rains even found time to improve the chemical processes. He introduced, for example, the method of steaming the mixed

[2] Rhodes, "History of the United States," Vol. V, pp. 390–394, The Macmillan Company, N. Y., 1919. Miller, "Photographic History of the Civil War," Vol. V, p. 161, The Review of Reviews Company, N. Y., 1912.

[3] Jefferson Davis, "Rise and Fall of the Confederate Government," V. 1, p. 477.

[4] "Photographic History of the Civil War," V. 5. Jefferson Davis, "Rise and Fall," pp. 316–317 and 475.

[5] "History of the Explosives Industry in America," by VanGelder and Schlatter, New York, Columbia University Press, 1927, pp. 107–118.

[6] "Du Pont. One Hundred and Forty Years," pp. 90–99, by Wm. S. Dutton, Chas. Scribner's Sons, 1942.

ingredients for gunpowder just before incorporation in the cylinder mills, which greatly increased the output, besides bettering the quality. When peace came, the Augusta plant was considered one of the most efficient in the world.

As the war progressed, Southern soldiers walked without shoes, lived on parched corn, went in ragged uniforms; but they always had enough ammunition, thanks to the unflagging efforts of Gorgas, Rains and Mallet, who never failed them.

The North, although more highly industrialized at the beginning of the Civil War, also had difficulties in procuring certain products, particularly saltpeter, all of which had to be imported from India. The ordnance department had let its supplies run low and in the fall of 1861, even before much large-scale fighting had taken place, a serious shortage of this critical material developed. Lammot du Pont, the youngest member of the du Pont family who owned the large powder plant in Wilmington, Delaware, was the outstanding chemical genius north of the Mason and Dixon Line. Lammot, then only thirty years old, had graduated from the University of Pennsylvania as a chemist at the age of eighteen. Six foot two, lanky, big-boned and gifted with an iron determination, he soon became a leader in the powder industry. After the end of the Crimean War, he went to Europe to study the latest advances in the art. Before going on this trip, however, he had perfected and patented a process by which Peruvian sodium nitrate could be used for blasting powder in place of saltpeter. This invention, and the work leading up to it, was destined to become a matter of national importance in the not distant future.[7]

When young du Pont became aware of the acute shortage of saltpeter and speculated on its portentous consequences, he asked for and was granted a conference with the Washington authorities; immediately afterward he sailed hurriedly for England to buy large quantities of saltpeter. He arrived there in November, and in a few days had acquired some 2,000 tons. Just when the four ships on which the material was loaded were ready to sail, reports of the *Trent* affair reached London. The British mail boat *Trent* had been stopped on the open sea by a U. S. warship, and, contrary to international law, two prominent Southern passengers, John Slidell and James Mason, had been forcibly removed as prisoners of war.

The British government, greatly incensed at this high-handed—and unauthorized—procedure, lodged a violent protest in Washington, asking for surrender of the two Confederates and an apology for their seizure. To show that her government was in earnest, the Queen declared an embargo on all munitions, and du Pont's boats with their precious loads were prevented from sailing. Excitement ran high, both in Great Britain and the United States. The British ambassador, on December 23, handed President Lincoln an ultimatum, to be answered within seven days. War between the two great English-speaking nations appeared imminent.

In the meantime, Lammot du Pont had returned to America and was in Washington on December 26th. What transpired there is not a matter of record, but can easily be surmised. If the Federal government could not get saltpeter from England or her possessions, the war was at an end. Wars could not be fought without powder, and powder could not be made without saltpeter. On December 30, 1861, Lincoln ordered the unconditional release of the two Southern emissaries. It was an unpopular decision but, although the public remained ignorant of his motives, the President had hardly any choice in the matter.

This little-known backstage setting to one of the Civil War's most stirring episodes had far-reaching consequences. Lammot du Pont was determined not to let the country be caught again in a similar critical situation. From Indian saltpeter he turned to the sodium nitrate deposits of South America, and succeeded even during the war in broadening the scope of his patented process so as to make it applicable also to the manufacture of gunpowder. The Indian monopoly was broken. From then on the United States ceased to depend for its supply of saltpeter on a European nation or her colonies.[8]

Thus the Civil War laid the foundation for the industrial development of the South and, still more important, for the military self-sufficiency of the United States. If wise leadership were to follow, the lessons of the fratricidal slaughter, learned at such bitter cost to both sides, would not be forgotten. The recent past was even then foreshadowing the events of the future. A big war, it was clearly shown, was no longer a mere clash of armed forces; it was a struggle between peoples and entire economic systems, essentially not much different from the competitive struggle between two large business enterprises. The South had starved in the midst of plenty because of its broken-down transportation and finances; the North had almost lost through poor management of its supply department. There was ground for hope that the re-United States would not allow a repetition of similar blunders, and that no attack would ever again find the war department without a thoroughly prepared, all-embracing business organization and an abundance of the most vital sinews of war.

[7] "E. I. du Pont de Nemours, A History," Houghton Mifflin Company, 1920, pp. 82–99.

[8] "Du Pont, One Hundred and Forty Years." "E. I. du Pont de Nemours, A History."

THE FIRST WORLD WAR

The first World War was characterized by one chemical achievement of such overwhelming interest that it outweighed all others. I am speaking of gas warfare. Aside from its novelty in modern combat, the introduction of this weapon carried with it the germ of a thought which, if it had been properly understood and interpreted, might have changed our entire conception of and preparation for warfare in general. Unfortunately for us, the Germans did develop the thought, and thereby gained an incalculable advantage over her opponents in the present world conflict.

I am not going to discuss at length the pros and cons of whatever moral issues may be involved in the use of poison gases. My personal opinion that gas warfare is no more evil than any other kind of human slaughter is, I believe, shared by most chemists. Attempts to outlaw it are bound to end in failure. Technical progress, whether for good or evil, can not be undone. Even if outlawed, the fear that the enemy will do the unlawful, would force us to keep all our knowledge and preparations up to date. The world has looked in turn upon arrows, Greek fire and gunpowder as illegitimate methods of combat and has tried to suppress them. Only twenty-five years ago, many voices were clamoring for the abolishment of submarines. No one advocates their abolishment to-day. Nations in mortal danger have always ignored peacetime treaties, for war itself is a denial of all laws and agreements. *Silent leges inter arma,* as the Romans put it, "when the arms speak, the law becomes silent." Two men on a rock-bound island fighting for the last crumb of bread or drop of water do not follow Marquis of Queensberry rules. But this is beside the point. The thought I have in mind tends in a different direction.

When the idea of a gas attack, on which German laboratories had worked for some time past, was first submitted to the German High Command, it was received with disdain. The graduates of Potsdam thought they knew all about warfare and wanted no advice from outsiders. It is said that only personal intervention by the Kaiser brought about a change of heart among the commanding generals. Nevertheless, they immediately set out to sabotage the plan, whether through lack of capability or malice is immaterial. The proper procedure would have been to call a conference of their leading chemists, inventors, military officers and business executives—the best brains of the country—to discuss the possibilities of this gas plan and perfect it before putting it to use. The businessmen, if men of vision, would no doubt have voted against its immediate adoption. Let there first be found a gas that was less visible, less odorous and not as easily identified as chlorine. Even a poker player would have advised against tipping a hand that held great possibilities, but still had to be played.

Months would have passed. Then the chemists would have submitted their improved product, phosgene. Invisible, insidious, highly poisonous, it would have broken the Allied front; for no soldiers can stand up against a weapon they can not see and against which there is no defense. Of course, the attack would have to be carried out on a long front, one hundred, two hundred miles at least, and be sustained by a full onslaught against the incapacitated or demoralized opponents. What if victory were achieved by means called unfair or even illegitimate? The world had a way of bowing to the victor, regardless of the means he had employed. One had only to read history for confirmation of this fact.

But the decision was not put into the hands of a board with vision; instead, it was left in the hands of men who had only the narrow view-point of the German military caste. Like the hungry man to whom a good fairy granted one wish and who asked for a meal when he could have asked for a King's ransom, the Germans made their gas attack on a three-mile front; they killed 5,000 Frenchmen and French colonials, injured 10,000 and captured 6,000 more. That was all. There were not even enough German troops in reserve to march through the breach to the English Channel, which they could have done.

This happened on the 22nd day of April, 1915. On the 23rd, 100,000 gas masks, hurriedly made from cotton pads saturated with reducing agents and chlorine-reacting compounds, were on the Allied front. The great peril was past. Germany's chemists had presented their country with a great opportunity to win the war with one stroke, and the general staff had exchanged the gift for a mess of pottage.

From a far-off perspective, this first modern gas attack deserves a much closer study than it seems to have received. Reduced to its simplest terms, this had been the problem. A big business concern, called Germany, had been offered a new invention that would speed up its output, in this case the killing or disabling of enemy troops. As in the case of any other invention, she asked her specialists to pass on its technical merits. The chemists approved. There was a gas called chlorine that could be taken to the front and used to kill people. The supply or manufacturing department affirmed its ability to produce chlorine cheaply and in large quantities. The invention was now submitted to those who had to use it, the plant managers and engineers, or in war, the general staff and the front line officers. They agreed, reluctantly and with understandable professional pride—or perhaps jealousy—that the proposed new method was

feasible; their main objection probably was that existing methods were satisfactory, and that the situation was well in hand. Now the invention should have been passed back to the board of directors, the big keen brains of the enterprise. Here was an invention that could not be patented nor kept secret for any length of time. What was the best policy to profit by it? Disregarding the character of the novelty, the directors would ask several pertinent questions. Could the invention be easily imitated? It could. Why not wait then until it was made more complex before putting it on the market? And when it was time to sell the article, let it be turned out in such big quantities, that competitors would be swept off their feet, and be out of the running before they could catch their breath. But the business firm called Germany had no board of directors; and having no board of directors, she missed her one golden opportunity to win the war.

In principle, there was no great difference between a novelty to be sold to the public and a new weapon called poison gas. Germany lost the first World War because she did not recognize that war had become Big Business; hence she had no board of directors to conduct the war in a business-like fashion. An invention which would have swung the balance was there, but its use was left to the discretion of one single department which muffed it. It was as if a big steel company would leave a question of fundamental policy in the hands of its distributing agents. They would be consulted, of course, but they would not be asked to carry the responsibility; for the introduction of new processes involves more than mere technical sales ability; it involves questions of finance, tariffs, patent laws and others that can only be weighed efficiently by shrewd and experienced groups of masterminds, not by specialists in any one line, no matter how brilliant. The proper utilization of poison gas was neither a purely chemical nor a purely military problem. In its larger sense it was a business problem, and its solution should have been left to the shrewdest business minds of the nation.

In its primitive stages war was a clash of brute force against brute force. By and by weapons were devised and improved, and those with novel arms were the most successful. The waxed bow of the Northern tribes, the short sword of the Romans, showed that technical ingenuity had its rewards even in the early stages of warfare. The men of the Macedonian phalanx were forerunners of our shock troops, the elephants forerunners of steel tanks yet to be invented. At the same time, strategy began taking the place of mere brawn. In spite of these developments, however, war was still largely a matter of soldiering. Just as the owner of a primitive iron furnace was his own chemist, engineer, salesman and credit department, so the primitive general embodied in his own person all the knowledge and ability necessary to organize, arm and lead his troops.

The graduates of Potsdam were finely educated soldiers, but they still thought of war in terms of rifles, siege guns, local strategy. They failed to recognize that modern wars had grown beyond the art of soldiering and had become an enormous business enterprise which they were not trained to conduct.

The German High Command did not properly evaluate what chemists could do, because they lacked the vision and experience of keen and successful businessmen. It was not they who failed; the system failed which they served. One simple businessman, unable to tell a machine gun from a revolver, but shrewd in the ways of the competitive world, sitting in conference with the military officers, might have kept them from the elementary error they were about to commit. His advice could have changed the course of history. But to have such an outsider take part in military discussions is something the German High Command would have considered ridiculous.

The first World War demonstrated that chemical ideas, properly utilized, can win wars. This does not mean, of course, that chemists alone can win them without cooperation from others. In order to win a war by means of a startling invention, or at least help win it, a coordination of four different types of mentality is needed, and they must work in harmony, like a well-organized athletic team or the integrated parts of an aggressive business enterprise.

First, we must have the imaginative type which envisions things that have never happened before; not visionaries who dream of perpetual motion, but minds that can visualize a gas adapted to warfare and base their dreams on sound chemical and physical principles.

Second, we need the specialist, the expert in the field to which the proposed invention belongs and who is competent to judge which dreams may be reasonably expected to come true. He need not be imaginative, but neither must he be hidebound, for it is up to him to translate a vision into an actuality, or else decide definitely that to do so is impracticable. This expert must have a large staff of chemists, physicists, engineers, physicians, mechanics and others at his beck and call, so as to carry new ideas to their completion.

The next man to take over is the man in whose hands the invention is to be placed. In commercial life we call him the distributor; in war he is the military officer at headquarters. It is he who must determine how the invention fits into his task at the front and work out the details of its proper application.

Had a gas best be ejected from projectors brought close to the enemy's lines, or should it be put into shells? Is it advisable to disguise the odor of a gas by the admixtures of other gases? These are questions on which his decision should be final. This officer must be a man of intelligence, for it is up to him to either carry out new ideas or else pass them back to the laboratory to strengthen them for actual combat use, but his authority should not be allowed to extend beyond these specialized tasks.

The fourth type of mind is that of the general director who has before him an over-all picture of the entire war and whose word alone can release the invention. His judgment, not that of the military staffs or any other groups, should decide if, when and how a new weapon is to be put to practical use. If he fails, the invention fails, no matter how meritorious it may be *per se*. The German generals should not have shouldered a responsibility that properly belonged to a type of mind they did not possess.

The great achievement of chemistry in the first World War was the lesson we learned—or should have learned—how to utilize new chemical ideas correctly. Gases may or may not play a prominent part in our present conflict, but other chemical inventions may take their place, carrying with them that element of surprise which is so essential to military success. If such an invention should be brought forth, it will undoubtedly be developed and used with full consideration of the lesson the Germans taught us unwittingly by their abortive gas attack at Ypres almost thirty years ago.

Above all, of course, the first World War confirmed what the Civil War had indicated—that war has become an enormous business and that its direction should no longer rest exclusively on the military branch of the government; strategy, arms and man-power have ceased to be the only means by which war is waged. Each nation needs in addition much other new equipment, such as a research department—scientists. But equally important is a board of directors to coordinate all branches and infuse into the whole structure the shrewdness, experience and all-around brain-power without which no Big Business can be successfully conducted.

(*To be concluded*)

SCIENTIFIC EVENTS

DEATHS AND MEMORIALS

DR. EDMUND S. CONKLIN, formerly head of the department of psychology of Indiana University, died on October 6 at the age of fifty-eight years. Before going to Indiana University, Dr. Conklin was head of the department of psychology at the University of Oregon.

DR. WINFIELD SCOTT HALL, since 1919 emeritus professor of physiology of Northwestern University, died on October 2 at the age of eighty-one years.

DR. FRANK WILLIAM MARLOW, professor emeritus of ophthalmology of the College of Medicine of Syracuse University, died on October 4. He was eighty-four years old.

DR. HERBERT POTTS, professor emeritus of oral surgery of the Dental and Medical School of Northwestern University, died on October 7 at the age of sixty-nine years.

THE death is announced, while a prisoner of Japan, of Dr. Robert Cecil Robertson, professor of bacteriology at the University of Hongkong and a member of the League of Nations Medical Mission. He was fifty-three years old.

Nature announces the death of Dr. L. Aschoff, professor of pathological anatomy at the University of Freiburg in Breisgau, aged seventy-five years, and of Dr. H. C. Lawrence, formerly of the Imperial Forestry Service, Burma, on August 25, at the age of sixty-seven years.

THE Soviet Academy of Sciences has set up a special committee, under the chairmanship of M. Krylov, the mathematician, who translated Sir Isaac Newton's works into Russian, to celebrate the tercentenary of Newton in December.

MICROFILM RECORDS OF THE LINNEAN SOCIETY OF LONDON

SOME time ago a grant was made by the Carnegie Corporation to the Linnean Society for the purpose of making a complete photographic record of all Linnean manuscripts and specimens. Although these documents were in storage outside London the task of photographing the material has now been completed. At the time the grant was made the officials of the Linnean Society offered to deposit a complete microfilm record in some American institution, and later the council of the society selected Harvard University as the place of deposit. The extensive series of microfilms, transmitted from London through British government channels, is now at the Arnold Arboretum. As soon as the necessary descriptive data are received these will be deposited at the Gray Herbarium, Harvard University. Once the material is organized arrangements will be made to supply

individuals and institutions with prints at the cost of reproduction.

E. D. Merrill

POSTGRADUATE COURSE IN INDUSTRIAL MEDICINE AT THE LONG ISLAND COLLEGE OF MEDICINE

The industrial health problem, measured by the soaring curve of accidents and absenteeism due to illness, appears to be most critical. It is well known that industrial illnesses and accidents are rising, at a rate which in some states is outrunning the rise in employment. Sound industrial health measures more widely applied should help to arrest this trend, conserve manpower and thus aid the war effort. These figures have been cited to indicate the scope and increasing gravity of the situation.

By the end of 1942 twenty million Americans will be at work in war plants—almost three times as many as were at work in such plants on January 1. Sixty million persons will have employment in all types of gainful occupation by the end of 1943. One third of these sixty million will be women, many of whom are new to industrial work. The rest will be men, most of whom are either too old, too young or who are physically unfit for service.

If the health problem in industry is critical now, consider what it will be when these millions of workers, most of whom are poor health risks and inexperienced in industrial work, are in the factories. In the last analysis industrial health is a medical problem. It is to the plant physician, be he full-time, part-time or "on call," that management must look in solving its health problems. Upon the medical profession rests the responsibility for safeguarding industrial health. Medical schools share in that responsibility, for they are one of the media through which training for medical service in industry is carried on.

The supply of physicians with industrial medical training is limited. Yet many more physicians with a grounding in industrial health are needed to serve in new and expanded war plants and in civilian industry and service. Many physicians now serving industry part-time or "on call" will be needed for full-time service, possibly in more than one plant.

Granting all this, the college had the problem of deciding on the type of course it would offer. It appeared that at least two conditions should be met: (1) the course should be so arranged that physicians within commuting distance could enroll and still carry on their practise; (2) the course should be organized to meet the requirements for grounding in the fundamentals of the subject that would fit the needs both of physicians with some experience in industrial medical practise and physicians with little or none.

In its planning the college had the benefit of the advice of a number of industrial physicians, notably Dr. Cassius H. Watson, medical director of the American Telephone and Telegraph Company, and Dr. John J. Wittmer, medical and personnel director of the Consolidated Edison Company, both of them alumni of the college. The principle they stressed from the start was: Keep it practical.

As it was finally developed, the course, which will be given from November 2 to 13, consists of two weeks of afternoon and evening lectures with morning clinics in the medical departments of industrial concerns. The material for the first week will cover the organization and operation of typical medical departments, physical examinations, study of absenteeism and a review of the human factors in industrial medical work. In the second week lectures and seminars on accidents and their prevention, industrial toxicology, traumatic surgery and nutrition have been scheduled. It was hoped that these topics would provide orientation in the main problems of industrial medicine for the physician new to this special type of practise and a new approach to some of these problems on the part of the physician with some experience in industrial practise.

A series of nine morning clinics, most of them to be held in medical departments of industrial concerns, have been arranged with the object of demonstrating to the students the subjects covered by the lectures of the previous day. A plan of internships of a month's duration in industry immediately following the course was devised for physicians who desire further training and who could be placed. Thirty-nine industrial physicians and experts in related fields such as compensation insurance will lecture in the afternoon and evening sessions. Twenty-three of these are from the metropolitan New York area and sixteen from other parts of the east.

The fee for the course is $50, $10 of which is payable in advance. Students may apply for admission for a part of the course, although they must elect to attend at least two full days of afternoon and evening lectures. The "per diem" charge is $5. The number of full-time students will be limited to fifty.

Alfred H. Crawford

THE VAUGHAN RESEARCH AWARDS IN HORTICULTURE

Awards of $500 each are to be provided by the American Society for Horticultural Science for the two outstanding papers of the year presented before the society. These awards are made possible through the generosity of L. H. Vaughan, of the Vaughan's Seed Stores of Chicago. They will be known as the Vaughan Research Awards in Horticulture. One award is to be made in the field of flori-

culture and one in vegetable crops. The awards for 1942 will be made at the winter meeting of the society in New York City which will be held from December 29 to 31, and will be selected from the papers which have been presented before the society during 1942.

Preference will be given to papers that present new discoveries in these fields, showing promise of commercial importance or practical application. Preference will also be given to papers by authors under thirty-five years of age. The papers will be judged on the basis of originality, soundness, accuracy, clearness and conciseness of presentation, and on the value of the work, especially in its practical applications.

The American Society for Horticultural Science was organized in 1903 to promote the science of horticulture. Its membership is composed of horticulturists and technical workers in horticulture in the United States, Canada, Mexico and abroad. Each year in connection with the annual meeting of the American Association for the Advancement of Science it holds a three-day program at which timely horticultural topics on fruits, vegetable crops, ornamental horticulture, floriculture, genetics, plant physiology and biochemistry are presented and discussed. In addition, round table discussions are held on such horticultural topics as varieties, educational methods, extension methods, nomenclature, research technic and special crops. Joint meetings are held with related science groups, such as phytopathology, genetics, soil science and botany.

In addition to the annual meeting, sectional meetings are held each year on the Pacific Coast, in the South and in the Great Plains area. The papers and discussions from these meetings are published by the society in two bound volumes of "Proceedings" amounting to approximately 1,200 pages each year. Dr. H. B. Tukey, Geneva, N. Y., is secretary of the society.

THE FIFTIETH ANNIVERSARY OF THE DEPARTMENT OF ZOOLOGY OF COLUMBIA UNIVERSITY

PROFESSOR LESLIE C. DUNN, executive officer of the department of zoology of Columbia University, announces that the department will celebrate on October 16 and 17 the fiftieth anniversary of its founding.

Dr. Nicholas Murray Butler, president of the university, will be the principal speaker at a dinner to be held in the Men's Faculty Club on Friday evening, October 16. Addresses tracing the progress of the department over half a century will be delivered by distinguished zoologists from other institutions who have received the Ph.D. degree at Columbia. Dr. James H. McGregor, recently retired from active service in the department to become professor emeritus, will preside.

Dr. Butler will speak on the origins of the department; Albert P. Matthews, professor emeritus of biochemistry at the University of Cincinnati, will review its early history with emphasis on the achievements of Professor Edmund B. Wilson in experimental embryology and cytology; Dr. Charles Packard, director of the Marine Biological Laboratory at Woods Hole, Mass., who received his Ph.D. in the department in 1914, will deal with the work of the department during his day; the development of the new science of genetics under Dr. Thomas H. Morgan and Dr. Edmund B. Wilson will be described by Dr. Curt Stern, head of the department of biology at the University of Rochester and formerly fellow of the International Education Board at Columbia; Dr. Alfred S. Romer, professor of zoology at Harvard University, will stress the connections of the department with the American Museum of Natural History, where Professor Henry Fairfield Osborn, paleontologist and first chairman of the department, was head of the division of mammalian paleontology, and Professor William K. Gregory now serves as curator of comparative anatomy and ichthyology. Dr. Meryl Rose, instructor in biology at Smith College, who received his Ph.D. at Columbia in 1940, will speak as a representative of his own day in the department.

A statement issued by Professor Dunn reads:

The work of the department from its inception in 1892 has centered in the study of evolution, heredity and the development and organization of the living cell and body.

The first chairman of the department, Professor Osborn, played a leading part in the investigation of the succession of animals of the past through their fossil remains. His associate, Bashford Dean, was a leading student of the fossil fishes and founder and first director of the Biological Station at Cold Spring Harbor.

Professor McGregor devoted himself to the study of the ancestry of men, and his reconstructions of primitive man based on fragmentary skeletal remains are familiar to most biologists. Henry E. Crampton, a member of the department since 1893, investigated the land snails of some of the Pacific Islands to confirm Darwin's contention that specific differences originate by the accumulation of individual differences.

Under the leadership of Thomas H. Morgan and Edmund B. Wilson, with the cooperation of Alfred H. Sturtevant, Hermann J. Muller, Calvin B. Bridges and others, the mechanism of Mendelian heredity was elucidated in detail, and the chromosome theory of heredity, or, as Morgan later called it, the theory of the gene, was developed at Columbia between 1910 and 1928.

Protozoology, the study of one-celled animals, had its American beginnings and underwent its chief development in this department, under the leadership of Gary N. Calkins.

The association of cytology and genetics continued after Wilson had retired, and Morgan had resigned to become director of the new laboratories at California In-

stitute of Technology, with Schrader and Pollister in the field of cytology, and in genetics, Dunn and Dobzhansky in the zoology department and Rhoades in the botany department. These five men continued the work of Morgan and Wilson on heredity in relation to evolution, to development and to the structure and behavior of the finer constituents of cells.

With the appointment of Professor Selig Hecht and the establishment of the Laboratory of Biophysics in 1926, physiology became a subject of advanced instruction and research. The work of that laboratory has been centered on the mechanisms by which organisms respond to light, and the work of Hecht has laid the basis for an understanding of some of the fundamental processes of vision.

The two-day celebration will end with open house and tea in the department on October 17.

SCIENTIFIC NOTES AND NEWS

THE autumn meeting of the National Academy of Sciences will be held in the Academy Building, Washington, D. C., on Monday, October 26. The meeting will be a business session for members only, and it is expected that the session will be confined to that one day, beginning at 9:30 A.M.

THE autumn general meeting of the American Philosophical Society will be held on November 20–21, beginning at 10 A.M. on Friday, November 20. The society will provide hotel entertainment for non-resident members and invited guests if they will notify the executive officer as soon as possible of their intention to be present at the meeting. For members and invited guests from a distance the society will, as usual, meet the regular hotel charges for rooms during the period of the meeting and for such meals as are not otherwise provided for by the society. On Friday, November 20, there will be a continuation of the program on the "Early History of Science and Learning in America" and on Friday evening a public lecture followed by a reception. On Saturday morning, there will be an executive session of the members followed by papers on various subjects and reports of progress by recipients of grants from the research funds. Dr. L. P. Eisenhart has succeeded as executive officer Dr. Edwin G. Conklin, who is now president of the society.

THE title of professor emeritus of psychology was conferred in September on Dr. Walter B. Pillsbury by the University of Michigan. Dr. Pillsbury, who reached the age of seventy years last July, has been a member of the faculty for forty-five years, having been appointed instructor of psychology in 1897.

Chemical and Engineering News states that Milton Kutz, who started work as an office boy forty-five years ago and is now assistant to the general manager of the Electrochemicals Department of E. I. du Pont de Nemours and Co., Inc., was given on August 3 a testimonial dinner by his associates.

DR. ELISE DEPEW STRANG L'ESPERANCE, a founder of the Kate Depew Strang Cancer Prevention Clinic of the New York Infirmary for Women and Children and associate commander of the Women's Field Army of the American Society for the Control of Cancer, was presented at a joint dinner on September 24 of the American Society for the Control of Cancer and the New York City Committee with the Clement Cleveland Medal, awarded annually by the New York City Cancer Committee "for outstanding contributions to cancer control work."

IT is reported in *Museum News* that officers of the newly established Minneapolis Science Museum Society have been elected as follows: Alger R. Syme, *president* (geological society); John S. D. Clark, *first vice-president* (bird club); Wensell Frantzich, *second vice-president* (astronomy society); Ward H. Benton, *treasurer* (mineral and gem club); and Miss Macy Spracher (botanical society). Milton D. Thompson is director of the museum. The society was organized on May 20 to combine all the organizations that have been using the Minneapolis Public Library Science Museum as headquarters. It will have control of the funds of the former "Museum Federation." It will endeavor to increase the membership in order to provide support for the museum, which has been struggling for its existence since the withdrawal of a WPA project.

DR. HERBERT E. LONGENECKER has been appointed associate professor of biochemistry and associate director of the Buhl Foundation projects in the University of Pittsburgh during the absence of Professor Charles Glen King, who is on leave to serve as scientific director of the Nutrition Foundation. Dr. King is also visiting professor of chemistry at Columbia University.

HENRY P. TREFFERS, instructor in biochemistry at the College of Physicians and Surgeons of Columbia University, has been appointed assistant professor of comparative pathology and biochemistry at the Harvard Schools of Medicine and Public Health.

DR. LAURENS H. SEELYE, formerly president of St. Lawrence University and recently assistant to Dr. Stephen Duggan, chairman of the Emergency Committee in Aid of Displaced Foreign Scholars, has gone to Istanbul, Turkey, where he will teach philosophy

during 1942–43 at Robert College and the Womans College.

R. V. SOUTHWELL, professor of engineering science at the University of Oxford, member of the British Aeronautical Committee, has been appointed rector of the Imperial College of Science and Technology, University of London, in succession to Sir Henry Tizard, who was recently elected president of Magdalen College, Oxford.

DR. ALBERT W. DAVISON, head of the department of chemical engineering and chemistry at the Rensselaer Polytechnic Institute, has been appointed director of research for Owens-Corning Fibreglass Corp., joint subsidiary of Owens-Illinois Glass Co. and Corning Glass Co., with laboratories in Newark, Ohio. He will take up the work on January 16.

DR. T. ROYDS, formerly director of the Kodaikanal and Madras Observatories, has been appointed professor of astronomy in the University of Istanbul.

DR. CHESTER M. SUTER, professor of organic chemistry at Northwestern University, has been appointed director of chemical research at Winthrop Chemical Company, Inc., at Rensselaer, N. Y.

DR. GRANT W. SMITH, assistant professor of chemistry at the University of Kansas City, where he has taught for the past seven years, has joined the research staff of the B. F. Goodrich Co., Akron, Ohio, as research chemist in the Koroseal Division. He will be engaged in research in polymerization.

DR. ROBERT B. HALL, professor of geography at the University of Michigan, has returned after a year's stay in Latin America, where he made a thorough study of Oriental settlements, with particular emphasis on Japanese colonization. He is now preparing a report on his findings for the Rockefeller Foundation.

DR. CHARLES F. SCOTT, professor of electrical engineering emeritus of Yale University, has been appointed a member of the Sectional Committee on Definitions of Electrical Terms of the American Standards Association.

BY an order of the British Privy Council, Professor David Keilin, Quick professor of biology at the University of Cambridge; Sir Henry Hallett Dale, director of the British National Institute for Medical Research and president of the Royal Society, and Colonel Sir Charles Glen MacAndrew, Member of Parliament, have been appointed members of the Medical Research Council.

A COMMITTEE has been formed under the chairmanship of Sir John Russell, F.R.S., to work with the British Allied Technical Advisory Committee on scientific problems connected with post-war agricultural reconstruction in devastated Europe. Another committee, with Dr. Dudley Stamp as chairman, will consider the further application of science to rural planning, as suggested at the conference on science and world order in 1941.

THE *Journal* of the American Medical Association reports that Dr. Thomas Parran, Surgeon General, U. S. Public Health Service, attended the Inter-American Conference on Agriculture as a counselor and as a guest of honor of the Federal Department of Health. He was received by President Avila Camacho and by the National Academy of Mexico. Dr. Parran visited the Institute of Tropical Diseases, the School of Hygiene and Public Health, the tuberculosis sanatorium in Huipulco, the Institute of Hygiene, the Central Laboratories and the Army Hospital. He inspected the malaria works in the state of Morelos and other services under the control of the Federal Department of Health and the Secretariat of Public Assistance.

CLIFFORD S. GARNER, assistant professor of chemistry at the University of Texas, is on leave of absence to enable him to work on a project under the National Defense Research Committee at the University of California in Berkeley.

THE twelfth Joseph Henry Lecture of the Philosophical Society of Washington was delivered on October 10 by Dr. Francis Bitter, associate professor of the physics of metals at the Massachusetts Institute of Technology. He will take as his subject "The Scientific Significance of Ferromagnetism."

PROFESSOR LAURENCE IRVING, of Swarthmore College, gave on October 12 an illustrated address before the section of biology of the New York Academy of Sciences. He spoke on "The Action of the Heart and Circulation of Seals, Beaver, and Other Diving Animals During Diving."

DR. THOMAS FRANCIS, JR., professor of epidemiology at the University of Michigan School of Public Health, Ann Arbor, will deliver under the auspices of the Xi chapter of Phi Beta Pi the annual Clarence Martin Jackson lecture of the University of Minnesota. He will speak on "Interpretation of Current Studies in the Control of Epidemic Influenza."

THE *Journal* of the American Medical Association reports that Dr. Eugene R. Kellersberger, New York, executive secretary of the American Mission to Lepers and formerly a medical missionary in Belgian Congo, Africa, delivered a lecture at the Mellon Institute on October 9, under the auspices of the University of Pittsburgh School of Medicine. The subject of the

lecture was "Twenty-Four Years' Experience with Tropical Diseases."

THE American Association of Civil Engineers held a joint meeting with the Engineering Institute of Canada at Niagara Falls, Ontario, from October 13 to 15.

THE thirty-first National Safety Congress and Exposition of the National Safety Council will be held in Chicago from October 27 to 29 under the presidency of Colonel John Stillwell.

THE new laboratory of electroencephalography at the School of Medicine of Stanford University was opened on October 8.

APPLICATIONS for research fellowships in medicine, dentistry and pharmacy in the University of Illinois are being considered for the year beginning on September 1, 1943. Appointments to these fellowships will be announced on January 1. Candidates must have completed a training of not less than eight years beyond high-school graduation. The fellowship carries a stipend of $1,200 a calendar year with one month's vacation. Application blanks and further information may be secured from the secretary of the Committee on Graduate Work in Medicine, Dentistry and Pharmacy, 1853 W. Polk Street, Chicago, Ill.

Museum News states that the Museum of Comparative Zoology, Harvard University, will discontinue with Volume 55 the memoir series of the museum, which was begun nearly eighty years ago. Decision to concentrate on scientific research is the reason. It is also reported that the *New England Naturalist*, published quarterly by the New England Museum of Natural History, Boston, since December, 1938, suspended publication with the February issue.

HARVARD COLLEGE will receive a residuary bequest of $259,089 under the will of Henry Osborn Taylor, author and historian, who died on April 13, 1941. The will directs that the bequests be applied toward the maintenance of salaries for members of the teaching staff.

THE University of California College of Pharmacy has been accredited by the American Council on Pharmaceutical Education and given membership in the American Association of Colleges of Pharmacy. In announcing this action, which places the College of Pharmacy on the same footing as other accredited colleges, Dean L. A. Schmidt explains that the delay in receiving this status was due to the reorganization of the curriculum and the modernization of laboratories and equipment which has been in progress for five years.

DISCUSSION

NEW EPIDEMIOLOGICAL ASPECT OF SPOTTED FEVER IN THE GULF COAST OF TEXAS

THE alarming increase of typhus fever in Texas, reaching in 1942 the highest figures in modern Texas history, was recently accentuated by a localized outbreak of spotted fever. Four children living in a wooded area of the Gulf Coast were attacked by this disease, which was fatal in two cases. Confluent hemorrhagic spots involving the skin of victims were the most spectacular symptoms on which the disease was diagnosed by Dr. B. Reading, professor of pediatrics. Gross pathology and histopathology were characteristic of spotted fever. Rickettsiae, coccoid in type, were found in endothelial cells of various organs.

Two strains of the infective agent have been established by the undersigned in guinea pigs inoculated with material from the above cases. After incubation of 2 to 4 days a high fever of from 6 to 9 days' duration developed in the infected animals. Mortality in guinea pigs is very low. Occasionally scrotal reaction has been noted. Intracellular coccoid Rickettsiae were found in sections of guinea pigs' organs.

The surviving guinea pigs were found immune against spotted fever strain from Montana kindly furnished by Dr. R. R. Parker but susceptible to flea- and louse-borne typhus strains.

The locality from which the cases came was found by us and by the entomologist of the Texas State Health Department to be infested heavily with the tick, *Amblyomma americanum*. Two specimens of the same species were also collected from the family of the victims. A thorough survey of the same area repeated two months later by U. S. Public Health Service and the Texas State Health Department again revealed *A. americanum* only among several thousand tick specimens collected. In both surveys no *Dermacentor variabilis* or any other type of tick was present.

These findings are of interest as they offer weighty evidence suggestive of spotted fever transmitted in nature by *A. americanum* as a new additional carrier of the disease. Experimental transmission tests by Parker, Philip and Jellison (1933) have proven *A. americanum* as an efficient carrier of Rocky Mountain spotted fever. The above authors have also discussed the possibility of *A. americanum* being a natural carrier of that disease but no case of spontaneous infec-

tion has been definitely attributed to this tick before the observations reported here. On the other hand, the genus Amblyomma is known to be a vector of spotted fever in Brazil and Colombia. Under these circumstances, the spotted fever of the Gulf Coast would be more closely related epidemiologically to that of South America than to that of the Rocky Mountains.

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ADDITIONAL STEROIDS WITH LUTEOID ACTIVITY

RECENT experiments lead us to believe that contrary to common opinion the progestational type of luteoid activity is detectable in many steroids and is not dependent upon the presence of an α-β unsaturated ketone group at C_3. Bioassays were performed on the immature rabbit according to McPhail[1] with the only modification of using 3 subcutaneous injections of 5 γ of estradiol in 0.1 cc of peanut oil subcutaneously every second day during the period of sensitization.

Since considerable confusion has been created in the literature by the inadequate description of steroids used for pharmacological assays, we shall refer to our compounds by their full systematic names [for terminology see Selye[2]] followed in brackets by their common names—whenever such are in use—and the melting point of our sample. The dosages given represent the total amount administered during the test.

The following steroids proved to possess progestational activity at the dose levels indicated: 17-ethyl-Δ^5-androstene-3(β)-ol-20-one (pregnenolone, M.P. 186°) 10 mg; 17-ethyl-Δ^5-androstene-3(β),21-diol-21 acetate (acetoxy-pregnenolone, M.P. 183–184°) 25 mg; 17-ethyl-Δ^4-androstene-3,11,20-trione-17,20-diol (Kendall's Cpd. "E", M.P. 215–218° (dec.)) 2 mg; 17-butyl-Δ^4-androstene-3,20-dione (21-ethyl progesterone, M.P. 115°) 10 mg; Δ^4-androstene-3,17-dione (M.P. 170°) 25 mg; Δ^5-androstene-3(β),17(α)-diol (androstenediol, M.P. 184–185°) 50 mg.

The following compounds proved to be devoid of progestational activity at the dose level indicated: Δ^5-androstene-3(β)-ol-17-one (dehydro-*iso*-androsterone, M.P. 146°) 50 mg; Δ^4-androstene-3,17-dione-6(α)-ol acetate (M.P. 176°) 4.5 mg; 17-*iso*-heptyl-Δ^5-androstene-3(β)-ol-25-one (27-nor-cholestenolone, M.P. 127–128°) 50 mg; the M.P. 180–182° epimer of Δ^5-17a-methylchrysopregnene-3(β),17a(?)-diol-17-one at 10 mg and its M.P. 275–278° isomerid at 5 mg.

It should be emphasized that the material available did not suffice in each case to perform a sufficient number of assays on a wide range of dosages and that there is considerable individual variation with regard to the sensitivity of rabbits to progestational compounds. Hence the doses at which we detected definite activity should not be regarded as accurate threshold doses suitable for quantitative comparisons, although positive tests are qualitatively conclusive. Pregnenolone and acetoxypregnenolone have been assayed at various dose levels on 20 rabbits so that the threshold dose of 10 mg for the former and 25 mg for the latter may be regarded as fairly accurately established. The fact that they both possess progestational properties indicates that neither the ketone group at C_3 nor the Δ^4-double bond are essential prerequisites for luteoid activity. It will be recalled that both these compounds are also endowed with corticoid activity,[3] but in this respect acetoxypregnenolone is more active. It appears, therefore, that in the Δ^5-3-ol series, as in the Δ^4-3-one series (confront with progesterone and desoxycorticosterone acetate), introduction of a 21-acetoxy group increases the corticoid, but decreases the luteoid potency.

A detailed description of these experiments as well as of the relevant literature will be given at a later date. At this time we merely wish to call attention to the fact that progestational activity is exhibited by many more compounds than has hitherto been suspected.

Acknowledgments: The cost of these investigations was defrayed from a grant given by the Hoffmann-LaRoche Company which, through its Montreal representative, Paul Blanc, also supplied some of the steroids used. The authors are also indebted to Professors E. C. Kendall, L. Ruzicka and Drs. G. W. Holden, E. Schwenk and H. Stavely for additional compounds.

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THE OCCURRENCE AND SIGNIFICANCE OF MARINE CELLULOSE-DESTROYING FUNGI[1]

IN the course of investigations on the decomposition of wood submerged in sea water the author has recently isolated a series of marine fungi which readily attack wood and other cellulosic plant materials under marine conditions. Extensive data concerning the distribution of these aquatic fungi show that they are of very common occurrence along the North Atlantic coast, with the present known range from Newfoundland to New York Harbor. Further evidence on the

[1] M. K. McPhail, *Jour. Physiol.*, 83: 145, 1934.
[2] Hans Selye, *Rev. Canad. de Biol.*, 1: 577, 1942.

[3] Hans Selye, SCIENCE, 94: 94, 1941.
[1] Preliminary note.

occurrence of these organisms will probably indicate a much more wide-spread distribution in oceanic waters.

Pure cultures of ten species of the marine cellulose-destroying fungi have been obtained from wooden test blocks which had been permanently submerged for six to ten months in the sea. Several other species have been isolated from specimens of decaying piling collected by the author in various Massachusetts harbors. The wooden test blocks as well as valuable data have been supplied through the courtesy of the William F. Clapp Laboratories in Duxbury, Mass. The organisms thus far isolated belong to the Pyrenomycete group of the Ascomycetes and to several groups of the Fungi imperfecti. In certain species the spores and the mode of spore dispersal indicate adaptation to aquatic conditions. In many cases the abundant occurrence of black perithecia on the surface of test blocks and other specimens has facilitated the isolation of pure cultures.

Histological and micro-chemical examination of infected material shows that the fungi bring about a rapid enzymatic hydrolysis of the cellulose in the thick secondary walls of plant fibers. The fungal hyphae penetrate with ease the cell walls of both hard and soft woods as well as those of the various fibers used in cordage. The exposed portions of plant materials attacked by the organisms exhibit a marked deterioration involving loss of cellulose and concomitant reduction in tensile strength.

Extensive studies of these fungi are now in progress to determine their rates of growth on various substrata.

Dr. David H. Linder, of Harvard University, is collaborating with the author in this series of investigations. A joint publication is now in preparation concerned with the morphology, taxonomy and physiology of these organisms.

It is deemed desirable to make a preliminary statement at the present time on the existence of these hitherto unreported marine fungi, owing to their extremely common occurrence and considerable economic significance, particularly in the destruction of cordage and other plant materials exposed to marine conditions.

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TOO HOT FOR THE DINOSAUR!

The point to the Dinosaurian bird resemblances is that these recur over a long reach of geologic time and never appear assembled in any one type. An allowable inference is that the Dinosaurs in the course of their long deployment made some approach towards warm-bloodedness; while the respiratory function may have varied markedly within the group as time went on. Certainly as the Cretaceous waned a much changed respiratory balance ensued. The photosynthetic oxygen release of the more and more distinctly dicotyledonous forests heralded the mammals and the birds.

Also, the laying down of heavy beds of coal and eras of limestone formation meant that an age-long abundance of aerial carbon dioxide, the breathing stimulus, was no more. There the Dinosaur failed; and in all his later life there is merely discernible a course of resistance to environmental change. Continental planation in later Cretaceous time was marked; but taking climate and the food supply there must have been left over many an "asylum" in which the Dinosaur could have lived on, bar that fatal lack of carbon dioxide. In its presence the Dinosaur had earlier lived through several periods of relative climatic warmth.

Admissibly, "the earth makes its own climates." Thus the surficial internal heat must have tended to lessen as Mesozoic times ended and the emergence of the Andines and the Rockies began. Global temperature was then merely normally warm for the Dinosaur far into northerly latitudes. Though, then, the plus and minus chemistry of respiration led to the end of that stupendous reptilian brood. In its stead arose the mammals and birds.

As between origin and extinction the atmospheric oxygen-carbondioxide ratio becomes a foremost factor. As assumed, a late Cretaceous withdrawal of much carbondioxide would have had a worldwide cooling effect fully balancing warming due to continental planation. Hence the time is here when the animal and plant physiologist and the geologist are much in need of coordinating their studies. For there stand adposed in the Mesozoic the Dinosaurs and the Cycadeoids. Were not the factors of origin and extinction complementary for both?

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THE DIFFUSION OF SCIENCE[1]

The individual scientist in the vanguard has been able to win to his understanding and eminence only by a lifetime of the most arduous and painstaking thoroughness. He has watched the pernicious social

[1] Excerpt from "The Diffusion of Science" by J. L. Bennett, Chapter III, pp. 51–53. The late Jesse Lee Bennett, of Baltimore, wrote and worked actively in the field of adult education and the diffusion of knowledge. He left a manuscript ten years ago which his mother has just had published by the Johns Hopkins Press, "The Diffusion of Science." This, to me, seems to be a very important book, and from it I have had a short excerpt copied which is so well expressed that I believe that it would be generally helpful to reprint it in the pages of Science.—Joseph L. Wheeler.

consequence frequently resulting from a few careless or hasty words on the part of some fellow scientist. He has come increasingly to understand the need for the most relentless precision of expression. He has come to realize ever more keenly the enormously complicated nature of all the phenomena investigated by science. He finds it increasingly difficult to make clear to untrained men the conclusions to which his patient, lifetime work have brought him. He finds himself perplexed and annoyed by the dangerous implicit fallacies and errors in the writings of "popularizers" seeking to give the general population some understanding of the work of himself and his confrères. For progress in his own speciality, unceasing concentration upon his researches is necessary. Inevitably he loses something of the common touch, he finds himself ever less interested in the reflection of contemporary life given by magazines and newspapers, he finds himself unable to give the attention necessary to understand the reality underlying contemporary political movements and bringing into prominence conspicuous political personalities. Naturally, he is drawn to those men who are equipped to understand his work—his fellow scientists throughout the world. Every day brings him reason to doubt the capacity of the masses of the population to understand the work with which he is concerned. When, occasionally, he seeks to lend assistance to movements apparently seeking social betterment he is generally perplexed or shocked by the obstacles, intrigues, and ignorances he encounters. However strong his sense of social responsibility, he finds it difficult or impossible to make any effective contributions save in his own work. He realizes that he is performing a highly specialized social function. He comes generally to feel that those concerned with the other highly specialized social functions of government, religion, journalism, education, are performing their tasks in the same spirit in which he attempts to perform his own and that any methods by which he might effectively cooperate with them are difficult to perfect and require thought and energy which his own activities do not allow him. As an actual problem confronting every scientist this situation and this conclusion seem inescapable. Yet, the fact remains that the body of thought with which these scientists, as a world-wide group, are concerned is relatively disinterested and comprises the most enduringly precious possession of mankind, while the activities and concerns of those dealing with government, finance, commerce and all the other complicated general social activities of man are inevitably influenced by considerations arising from self-interest. They are, moreover, socially valuable only to the degree in which they are influenced by the broad social vision which can result only from the knowledge gained from these men in the vanguard, insulated from the great mass of the population and isolated from the daily concerns of men by the wall which all the considerations we have stressed have served to erect.

QUOTATIONS

THE FOOD-PRODUCING POWER OF GREAT BRITAIN

THREE years of war have seen a great increase of our food-producing power. In this time, in what is potentially from the standpoint of the scientist a magnificent agricultural country, agriculture has been more substantially improved than in any previous period, even ten times as long.

To four factors are due the progress made: the farmers and their workers, the Women's Land Army, a great increase in mechanical power on the land, and the application of scientific knowledge. And influencing the form of the progress made has been the policy of the Government, with three outstanding aspects: (1) to plough up grassland for the production of crops for man; (2) to adjust livestock numbers; and (3) to ensure better farming and more from every acre.

In all this the application of science has played an important part. For instance, a large part of the success of the ploughing up campaign may be attributed to making good deficiencies in the soil. There were large stretches of soil which, deficient in lime or phosphates, would not produce good crops or grass. Farmers, by practical experience, had discovered the cause and acquired skill in dealing with it; but science has now supplied a complete remedy. It has been widely applied by the various agents of the Ministry of Agriculture, and in consequence many thousands of acres which had a poor reputation formerly have been made to yield handsome crops. Giant machines and gelignite have helped to reclaim for cultivation swampy fen, the tree-covered tops of downs and bleak mountain sides, but the foundation on which this activity rested was knowledge of the soil and application of the necessary fertilizers.

Last year alone scientific staffs supplied by the Ministry of Agriculture were responsible for 115,000 separate analyses of soil. The wire worm—the grub stage of a little beetle—which can do enormous harm to crops, has baffled the best scientists throughout the world for years, and no remedy is yet known. However, scientists can indicate whether a given piece of land contains many or few of these pests and so advise

what should be grown there. There may be 1,500,000 wire worms to an acre, and the only way to count them is to take a sample of land here and there. Where this number exists, it means that there is one to every four square inches of land, or, put in another way, one and a half wire worms are waiting to eat every seed sown were wheat to be sown there.

Many of the problems of the Minister of Food are shared by the Minister of Agriculture, for the farmers, too, have their heavy workers (horses), their expectant and nursing mothers, and their children, not all of one breed. The two main features of the national livestock feeding plan are rationing, which is so complete that it caters for every animal on every farm and the backyard pigs and hens as well, and the growing of more food for livestock on every farm.

Last year farmers were set the target of an increase of 5 per cent. in output from every acre. If that were achieved it would save well over 1,000,000 tons of shipping. There can be little doubt that it has been achieved, according to one well qualified to judge, and the reasons are favorable weather and better farming, which, as well as better effort, meant the application of scientific principles. Prominent here have been the wide-spread introduction of ley farming and the wise use of fertilizers, including a top dressing administered at the right time.

In these war years the link between the farmer and the scientist has been greatly strengthened. In every county there is a county organizer, with a staff, who works with the war agricultural executive committee, and from whom the farmer can obtain advice on every aspect of his work. He is able to refer special difficulties to thirteen advisory centers, where highly specialized workers in the agricultural sciences are able to answer his questions. These centers must be fed from research institutes, of which there are now a great number. But the scientific knowledge available to the farmer is drawn from the whole world. There is maintained in England on behalf of the Empire a series of imperial agricultural bureaus whose work it is to abstract and present in convenient form the scientific knowledge of the entire world.—Food correspondent of *The Times,* London.

SCIENTIFIC BOOKS

ELECTRICITY AND MAGNETISM

Electricity and Magnetism. By Norman E. Gilbert. Revised edition. New York: The Macmillan Company. 1941. $4.50.

In producing a revised edition of this well-known text many changes have been made. The material on power engineering, some of which seemed rather out of place in a physics text, has been abbreviated, but the sections dealing with electron tubes and their uses have been rewritten and brought up to date. Sections have been added on the theory of dielectrics, moving electrons and electron optics and on the recently proposed systems of units. The last chapter contains a good elementary introduction to the physics of the nucleus.

It should be remarked that a number of statements still occur which might be questioned by advanced students of the subject. This is doubtless not an easy fault to avoid, however, for few of us can hope to become experts in more than one or two lines. Perhaps users of text-books should form the habit of not relying too strongly upon incidental statements without checking their validity by reference to more advanced treatises.

The book constitutes, as it did in its original form, a good introduction to the entire field of electricity and its applications. It is designedly more elementary on the theoretical side than the standard text of Page and Adams, but the treatment is careful, thorough and easily understood. Ample lists of problems are included.

E. H. Kennard

Cornell University

A BIBLIOGRAPHY OF AVIATION MEDICINE

A Bibliography of Aviation Medicine. By Ebbe Curtis Hoff and John Farquhar Fulton. 237 pp. Charles C Thomas. $4.00.

A timely and much-needed bibliography of aviation medicine has been prepared by Ebbe C. Hoff and John F. Fulton, of the Department of Physiology of the Yale School of Medicine. This work was done under the auspices of the National Research Council Committee on Aviation Medicine, acting for the Committee on Medical Research of the Office of Scientific Research and Development. It is now available for investigators in this country. The labor has been extensive, as there are over 6,000 citations from 800 journals. References are well classified according to subjects and there are many cross references, for example, 107 under "Hemoglobin."

Unusual care has been taken with make-up and typography and the George Banta Company deserves much credit for the press work. This carefully prepared, comprehensive bibliography will prove invaluable not only for investigators of aviation physiology and medicine but also for the many physiologists working in related fields.

Eugene F. Du Bois

SPECIAL ARTICLES

THE ABSORPTION AND DISTRIBUTION OF INSULIN LABELLED WITH RADIOACTIVE IODINE[1]

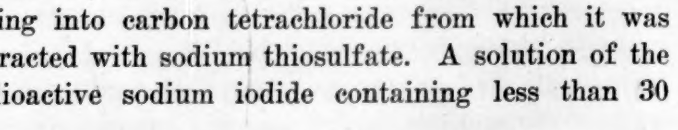
THE measurement of the absorption rate of insulin from the site of depository injections is of practical interest. While it is usually estimated by its indirect effect on the blood sugar level, Beecher and Krogh[2] have studied the absorption of insulin after an injection of protamine insulin into a rabbit's ear, using methylene blue as a tracer. The distribution of insulin in the body has been studied only by determining the insulin content of blood and pancreas by the insufficiently accurate method of extraction followed by biological assay. Since biologically active and crystalline insulin derivatives have been prepared containing heavy atoms, as iodine and arsenic,[3] it became possible to prepare a radioactive insulin derivative containing radioactive iodine. We have attempted to follow the absorption and distribution of insulin after injection, by using insulin-p-azoiodobenzene containing about 2 azo groups per insulin molecule.

EXPERIMENTAL

We were faced with the problem of introducing a sufficient amount of radioactivity with the smallest number of iodobenzene azo groups into insulin so that the resulting derivative be as nearly similar to insulin as possible and yet have sufficient radioactivity for measurement in the small amount of insulin which is tolerated by the experimental animals.

Preparation of Iodoaniline. Morton's[4] micro technique was used in the synthesis of iodoaniline according to the following reactions:

(1) $KIO_3 + 5\,KI + 6\,HCl \rightarrow 3\,I_2 + 3\,H_2O + 6\,KCl$

(2) 

Radioactive iodine containing isotopes of 8-day and 12.6-hour periods was prepared by the deuteron bombardment of tellurium.[5] The iodine was extracted from the tellurium target by adding potassium iodide as carrier, dissolving it in nitric acid and then distilling into carbon tetrachloride from which it was extracted with sodium thiosulfate. A solution of the radioactive sodium iodide containing less than 30 micrograms of iodine was evaporated to a volume of about 0.05 cc. The iodine was liberated by acidification with hydrochloric acid and addition of an excess of potassium iodate, both the acid and the iodate being contained in about 0.01 cc. A small excess of aniline was added after first making alkaline with sodium bicarbonate and the mixture was stirred intermittently for a half hour. Since the sodium iodide which is formed in this reaction must contain at least half of the radioactivity, iodine was again liberated by the addition of potassium iodate and acid, using about half the amounts of reagents used before. In one experiment this was repeated a third time, this procedure allowing for the introduction of more than half of the available radioactivity.

Preparation of the Insulin Azo Derivative. The mixture was acidified with hydrochloric acid, cooled to 0° and the iodoaniline diazotized by the addition of sodium nitrite. The reaction was practically complete in half an hour. Five mg of insulin dissolved in the minimum amount of N/10 hydrochloric acid were then added, and the solution brought to a pH of from 8–9 for coupling. The solution was allowed to stand for at least an hour and sometimes over night. The insulin azo dye was then precipitated three times at its isoelectric point in the presence of non-radioactive potassium iodide, iodophenol and p-iodoaniline. From this material a solution was prepared containing 80 units of insulin per cc.

Absorption Rate Determination. Ten rabbits were injected subcutaneously with 2/3 units/kg. One or two of the animals were killed at given intervals and the skin at the site of the injection and corresponding parts of the abdominal wall was excised. Blood samples for sugar determination were taken just previous to killing the animals, and at the same time from all the other animals which had not as yet been operated on. Ten mg of potassium iodide were added to the skin samples as carrier and the skin and added iodine oxidized with a chromic and sulfuric acid mixture.[6] After reduction with oxalic acid the iodine was distilled into carbon tetrachloride. The completeness of the recovery of iodine was checked by titration with sodium thiosulfate. Activity measurements on the titrated aqueous solution were made with a Geiger counter.

The technique of following the rate of absorption could possibly be simplified and made more accurate by carrying out the experiment in intact animals and applying the Geiger counter with appropriate filters directly to the site of injection. This technique proved to require a higher specific radioactivity than was present in the preparations originally made.

[1] This investigation was aided by a grant from the Josiah Macy Jr. Foundation.

[2] H. K. Beecher and A. Krogh, *Nature,* 137: 458, 1936.

[3] E. H. Lang and L. Reiner, SCIENCE, 93: 401, 1941.

[4] A. A. Morton, "Laboratory Technique in Organic Chemistry," McGraw-Hill, New York, 1938.

[5] The authors are indebted to Professor Robley D. Evans, of Massachusetts Institute of Technology, and Professor John R. Dunning, of Columbia University, for their kindness in preparing the radioactive iodine.

[6] Joseph G. Hamilton and Mayo H. Soley, *Am. Jour. Phys.,* 127: 557, 1939.

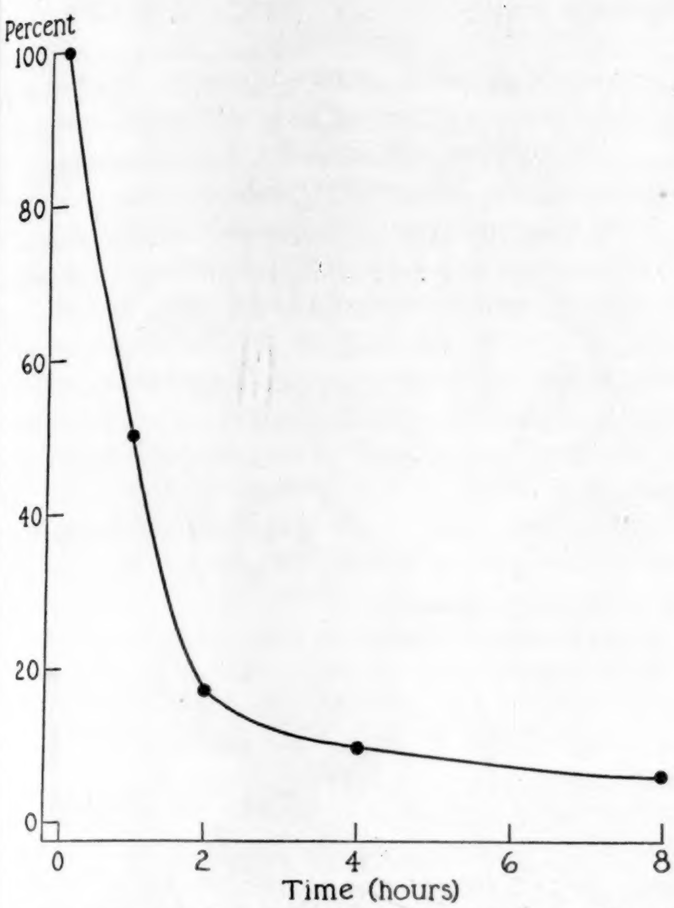


FIG. 1. Per cent. radioactivity remaining at site of injection.

In Fig. 1 the percentage of radioactivity remaining at the site of injection is plotted against time.

In Fig. 2 is shown the relation between the rate of

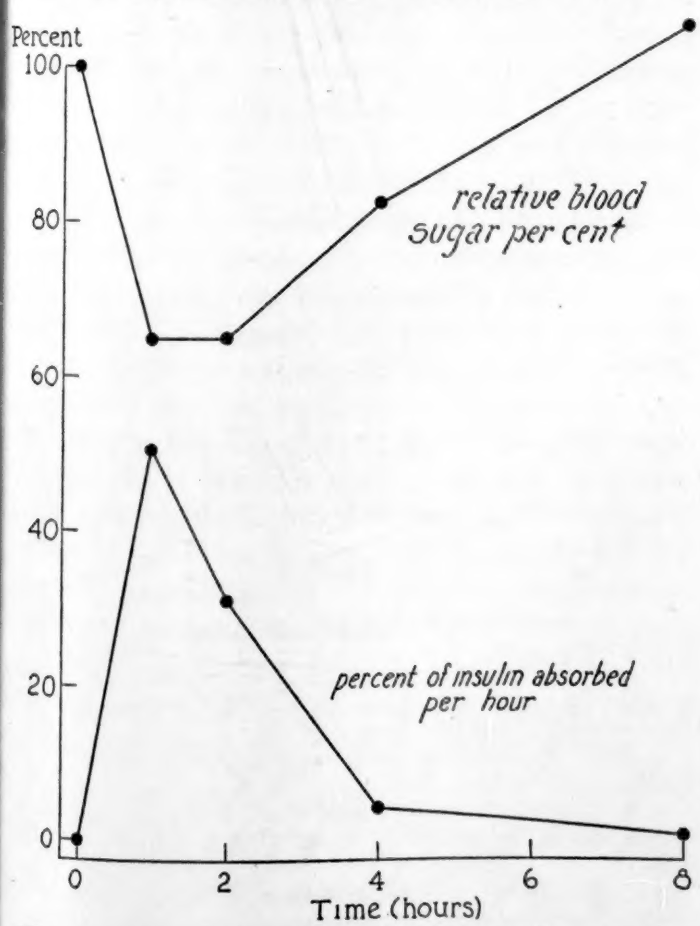


FIG. 2. Comparison of the rate of absorption of radioactive insulin with blood sugar levels.

absorption of radioactive insulin (*i.e.,* the percentage of radioactive material absorbed per hour since the last measurement) and the blood sugar at various times following the injection. From this graph it appears that the time of maximum rate of absorption is soon followed by the maximum drop in blood sugar. Also, as the absorption rate drops to very low values, the blood sugar rises to its original level. There is still a small but measurable activity when the blood sugar has risen to its original level. This may be due to the presence of some denatured insulin.

Preliminary experiments were conducted on the distribution of the radioactive insulin, in rats injected intravenously and intracardially. An hour after injection the circulating blood contained a considerable fraction of the radioactive material. Relatively large quantities of radioactive material were found in the liver and kidneys, suggesting concentration of insulin by these organs.

Since part of the azo groups may be split off from the insulin by reduction in the body, distribution experiments of this type can be of value with regard to the physiology of insulin only if the rate of decomposition of the insulin derivative is also determined. However, as the reduction of azo compounds is relatively slow, it seems probable that in short experiments the distribution of the label would reflect the distribution of insulin in the body.

The technique described above represents a simple means for testing the rate of absorption of insulin depot preparations such as globin and protamine insulin.

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COLCHICINE INDUCED UNIVALENTS IN DIPLOID ANTIRRHINUM MAJUS L.

THE spindle inhibiting effect of colchicine in mitosis and meiosis in both animals and plants is well known. However, the extent to which colchicine may affect the chromosomes themselves is less definitely established. Spiralization seems to be influenced by colchicine and a fusion or stickiness of the chromosomes frequently follows colchicine treatment. A low frequency of induced chromosomal aberrations and an altered mutation rate may also result. A disturbing effect on chromosome pairing and crossing over has also been reported. Walker,[1] Levan[2] and Dermen[3] found uni-

[1] R. I. Walker, *Amer. Jour. Bot.,* 25: 280–285, 1938.
[2] A. Levan, *Hereditas,* 25: 9–26, 1939.
[3] H. Dermen, *Jour. Hered.,* 29: 211–229, 1938.

valents a few days after treatment which they attribute to asynapsis or desynapsis. On the other hand, Darlington[4] reports that colchicine induces crossing over in regions where it is normally excluded. Further data on the influence of colchicine on meiotic chromosome pairing is presented in the present paper and the results treated statistically.

Young potted cuttings from a white-flowered clone of *Antirrhinum majus* L. (2n = 16) were treated by immersion in aqueous solutions of colchicine (0.1, 0.15 and 0.25 per cent.) for periods ranging from seven to 42 hours. After treatment the plants were grown in the greenhouse until flower buds were sufficiently developed to obtain pollen mother cells. The time elapsed between treatment and fixation varied from 6 to 15 weeks. Control material was collected from untreated plants of approximately the same age, most of which had been immersed in water while the treated plants were in the colchicine bath.

The number of lagging univalents at first anaphase were scored for one hundred or more cells from each of 30 control and 52 treated branches. The number of cells examined and the percentage of cells with 0, 1, 2, 3 and 4 laggards are given in Table 1. In the

TABLE 1

PERCENTAGES OF CELLS WITH 0, 1, 2, 3 AND 4 UNIVALENTS IN CONTROL AND COLCHICINE TREATED DIPLOID ANTIRRHINUM MAJUS L.

		Univalents					Total number of cells
		0	1	2	3	4	
Controls	Actual	3765	48	52	0	1	3,866
	Percentage	97.387	1.242	1.345	0	0.026	100
Treated	Actual	6596	96	144	4	1	6,841
	Percentage	96.419	1.403	2.105	0.058	0.015	100
		$\Sigma\chi^2 = 9.324$		df* = 2		P = < 0.01	

*There are only two degrees of freedom because the numbers of cells with 3 and 4 univalents are too small to be considered separately and must be added to the two univalent class.

control plants 2.61 per cent. of the cells had one or more laggards, while the treated plants had 3.58 per cent. This is an increase of about 37 per cent. The χ^2 test shows that the probability of a difference of this magnitude being due to chance alone is less than one per cent. (Table 1) or if all the cells with laggards are grouped together the fourfold table test of goodness of fit again shows the probability to be less than one per cent. The increase in number of univalents can, therefore, be regarded as highly significant.

Since the univalents probably result from a decrease in number of chiasmata it can be concluded that colchicine must reduce crossing over in at least one pair of chromosomes. In the majority of the material examined meiosis did not occur until eight weeks or longer after the treatment. This would indicate either that colchicine or colchicine derivatives must remain in the plant for a considerable length of time, or that the treatment alters the structure of the chromosomes to such an extent that normal crossing over and chiasma formation is inhibited in a small percentage of cases. Complete inhibition of all crossing-over has been reported in pollen mother cells examined a few days after treatment. So far as the author is aware no previous reference has been made to such a long-term effect of colchicine on chromosome behavior.[5]

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[4] C. D. Darlington, John Innes Hort. Inst. Ann. Report for the year 1940.

[5] This work was largely done under Bankhead-Jones Project Nos. 3 and 4 at the New York State Agricultural Experiment Station, Geneva, N. Y.

CRYSTALLIZATION OF A PROTEIN FROM POLIOMYELITIS INFECTED MOUSE BRAIN[1]

A FRACTION which is essentially protein in nature has been obtained from the brains of mice infected with poliomyelitis virus. This fraction is birefringent, and the washed material (crystalline or liquid crystalline) is infective, producing typical symptoms of poliomyelitis. It was obtained by the following procedure: poliomyelitis infected brains were frozen and kept in a box with dry ice. Throughout the procedure the temperature was maintained at or below 0° and all manipulations were carried out under sterile precautions. Groups of between 10 and 15 brains were thawed and then extracted twice with saline 1:10 for one hour at pH 7.8. After centrifugation for 30 minutes at 2,500 R.P.M., the supernatant fluid was shaken with an equal volume of ether, which was added in small portions to the brain extract in a separatory funnel. Complete separation usually occurs after 6 to 8 hours in the refrigerator. The lowest layer in the separating funnel is only slightly opalescent and contains most of the virus.[2, 3, 4] From this layer, after separation, ether was removed by negative pressure. The solution was adjusted to pH 4.0 with N acetic acid and centrifuged. The supernatant (I) was kept separate. The precipitate was resuspended in saline, the pH adjusted to 8.0, thoroughly mixed with a glass rod and again centrifuged (supernatant

[1] Aided by a grant from the National Foundation for Infantile Paralysis, Inc.

[2] B. Howitt, *Proc. Soc. Exp. Biol. Med.*, 28: 158, 1930.

[3] M. Schaeffer and W. Brebner, *Archives Path.*, 15: 221, 1933.

[4] P. F. Clark, A. F. Rasmussen and W. C. White, *Jour. Bact.*, 42: 63, 1941.

II). Supernatant I and II were mixed and kept in a dry ice-box. The extracts obtained by the above procedure from several groups of infected brains were combined. This mixture was precipitated with 1.6 M ammonium sulfate at pH 7.0. The mixture was centrifuged and the precipitate discarded. The supernatant was then reprecipitated at pH 5.6 with 2.3 M ammonium sulfate and left for two hours in the refrigerator. The centrifuged precipitate was suspended in physiological saline and dialyzed in a Cellophane tube against saline for three days. The saline was changed every few hours. The dialyzed solution was brought to a pH of about 4.3 with n/10 acetic acid and the centrifuged precipitate discarded. To the clear, colorless supernatant n/100 acetic acid was very carefully added, drop by drop, until a first precipitate appeared. This precipitate was examined under a polarizing microscope and was found to consist partly of birefringent matter. One of these conglomerates was separated, washed in n/1000 acetic acid and dissolved in a small amount of dilute NaOH. It dissolved with difficulty. It proved highly infective for mice, producing typical paralytic symptoms of poliomyelitis after intracerebral inoculation in 14 to 72 hours. Another group of mice treated with omission of the ether extraction and with slight modifications of the above-mentioned method gave a somewhat better yield of the crystalline material. The data on this latter method are, however, still incomplete.

Another conglomerate was separated under the polarizing microscope and an x-ray diffraction photo of the wet material was taken by Dr. Fankuchen. It showed, in addition to some undifferentiated low angle scattering, a distinct though diffuse halo at an angle corresponding to about 4.5 Å. A halo of this character seems to be characteristic of protein material.[5, 6]

As encouraging as these data are it must be stressed that there is no evidence and no claim that the crystalline material obtained by this procedure represents the poliomyelitis virus. The possibility that the virus is adsorbed on the protein can not be excluded.

The author is under deep obligation to Dr. I. Fankuchen for his encouragement and advice as well as for the x-ray diffraction photograph.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

ON A NEW PROTEASE FROM PILEUS MEXICANUS[1]

Pileus mexicanus is an arboreous plant about eight meters high, belonging to the family of the Caricaceae; it grows wild in different states of Mexico (Morelos, Guerrero, Colima, Campeche y Yucatan), and is commonly known as "cuaguayote." From fruits and leaves a latex is obtained that has great activity, similar to that of papaya. The latex, collected by making longitudinal incisions on the fruits, clots rapidly, becoming brownish yellow in color.

After drying the latex in vacuum at 45° C it becomes easy to pulverize, yielding a white powder, similar to pulverized papain.

The enzymatic activity was determined by the milk-clotting method (Balls and Hoover)[2] and by titulation with alcoholic KOH (Willstätter, Waldschmidt-Leitz, modified by Balls).[3] Table I shows the activity obtained.

TABLE I

Mg of enzyme	Activator	pH	Clotting time in seconds	Milk-clotting units	cc of alcoholic KOH
1	None	4.6	60	1.00	....
1	Cystein 0.05 M.	4.6	50	1.20	....
5	None	4.7	..	....	1.10
5	H_2S	4.7	..	....	1.35

The corresponding values obtained by Balls for raw papain[4] in milk-clotting units are 1.11 after activation with Na CN and 1.09 non-activated per mg of latex. By titulation with alcoholic KOH, the maximum activity obtained by Balls on 5 mg of raw papain is 1.00 cc after activation with H_2S. These values show that this enzymatic preparation has a slightly superior activity to papain.

Similarly to other enzymes of the papain type, it is activated by HCN, H_2S and cystein, and rendered inactive by H_2O_2 and I_2. However, the papain clots the citrated blood, while the protease from Pileus does not. Its antihelminthic power was tried on *Ascaris lumbricoides, Macracanthorhynchus hirudinaceus, Oxyurus equi* and an Ankylostomid, being strongly positive in all cases.

The control specimens, in boiled enzyme, remained alive eight hours after the experiment was begun.

[1] Syn. *Jacaratia mexicana* (Sessé et Moc. ex D.C.); *Pileus heptaphyllus* (Sessé et Moc.), Ramirez; *Leucopremna mexicana* (Sessé et Moc.), Stanley.

[2] A. K. Balls and S. R. Hoover, *Jour. Biol. Chem.*, 121: 737, 1937.

[3] A. K. Balls, T. L. Swenson and L. S. Stuart, *Jour. Assoc. Off. Agr. Chem.*, 18: 140–146, 1935.

[4] A. K. Balls, H. Lineweaver and S. Schwimmer, *Indust. and Eng. Chem.*, 32: 1277, 1940.

[5] J. D. Bernal, I. Fankuchen and M. Perutz, *Nature*, 141: 523, 1938.

[6] I. Fankuchen, *Annals New York Acad. Sciences*, 41: 157, 1941.

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TABLE II

ANTIHELMINTHIC ACTIVITY ON ASCARIS LUMBRICOIDES FROM INTESTINE OF THE PIG. (pH 5, BUFFERED WITH CITRIC ACID AND DISODIC PHOSPHATE, AT 40° C)

Enzyme concentration	2 hours	4 hours	8 hours	24 hours
1 per cent.	An ulcer attaining body cavity	Partial digestion	Intense digestion	Total digestion
0.5 " "	Several ulcers	Incipient digestion	Partial digestion	Total digestion
0.1 " "	No change	Several ulcers	Incipient digestion	Partial digestion
0.05 " "	No change	No change	Several ulcers	Partial digestion

The fresh latex and dry weight relation is 30 per cent., while in papain it is only 20 per cent.

Pileus mexicanus is quite abundant in Mexican tropical regions, making its industrialization possible, to compete with papain. Methodic breeding of the plant would be an important source of the enzyme. We propose the name of "mexicain" for this enzyme.

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FUNGICIDAL VALUE OF THE SALICYLATES

THE problem of finding suitable substitutes for copper fungicides is becoming increasingly important. In recent discussions, prominent mention has been made of such organic compounds as phenothiazine, tetramethyl thiouram disulfide and ferric dimethyl dithio carbamate. However, one of the major needs for copper fungicides is in the control of various downy mildew diseases (caused by species of *Phytopthora, Peronospora* and *Pseudoperonospora*), and information as to possible copper substitutes in this field appears to be lacking. During the past ten years, the Bureau of Plant Industry, in cooperation with the state experiment stations of Georgia, South Carolina, North Carolina and Maryland, has conducted an extensive search for sprays effective against the blue mold or downy mildew disease of tobacco. The organic compounds mentioned above have been tested along with numerous others. Most promising results have been obtained with the salicylates, practically all of which were more or less effective. The best of these compounds so far tested has been bismuth subsalicylate, used at the rate of 1½ pounds, plus 1 pound of Vatsol O.T.C. (sodium dioctyl sulfosuccinate) in 100 gallons of water. With the aid of the wetting agent, the subsalicylate makes a quick and stable suspension, and the spray adheres very well to tobacco leaves. This spray used against blue mold has given excellent control, with strong residual protection after spraying was discontinued, and no plant injury. It has been superior to the regular copper oxide-oil in all three respects, and the copper oxide-oil has, in turn, been much superior to bordeaux mixture. The second best of the salicylate mixtures so far developed has been benzyl salicylate, one fourth pound dissolved in 1 gallon of cottonseed or soybean oil, emulsified and diluted to 100 gallons. This mixture has been very effective, but has occasionally caused plant retardation, and it does not have quite the residual protection of the previous. Salicylic acid and zinc salicylate at the rate of one half pound dissolved in 1 gallon oil, emulsified and diluted to 100 gallons, have been effective fungicides, but likely to cause plant injury. Materials showing some promise are butoxyethyl salicylate, dinitrosalicylic acid and salicyl salicylic acid, all at the one half pound rate in oil. So far, most of the salicylates do not appear to be critical materials, but difficulties regarding availability and price may be expected. It would seem most important to find out as soon as possible what fungicides can be used against each specific disease, and it would not be surprising if very much improved spray treatments would ultimately result.

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